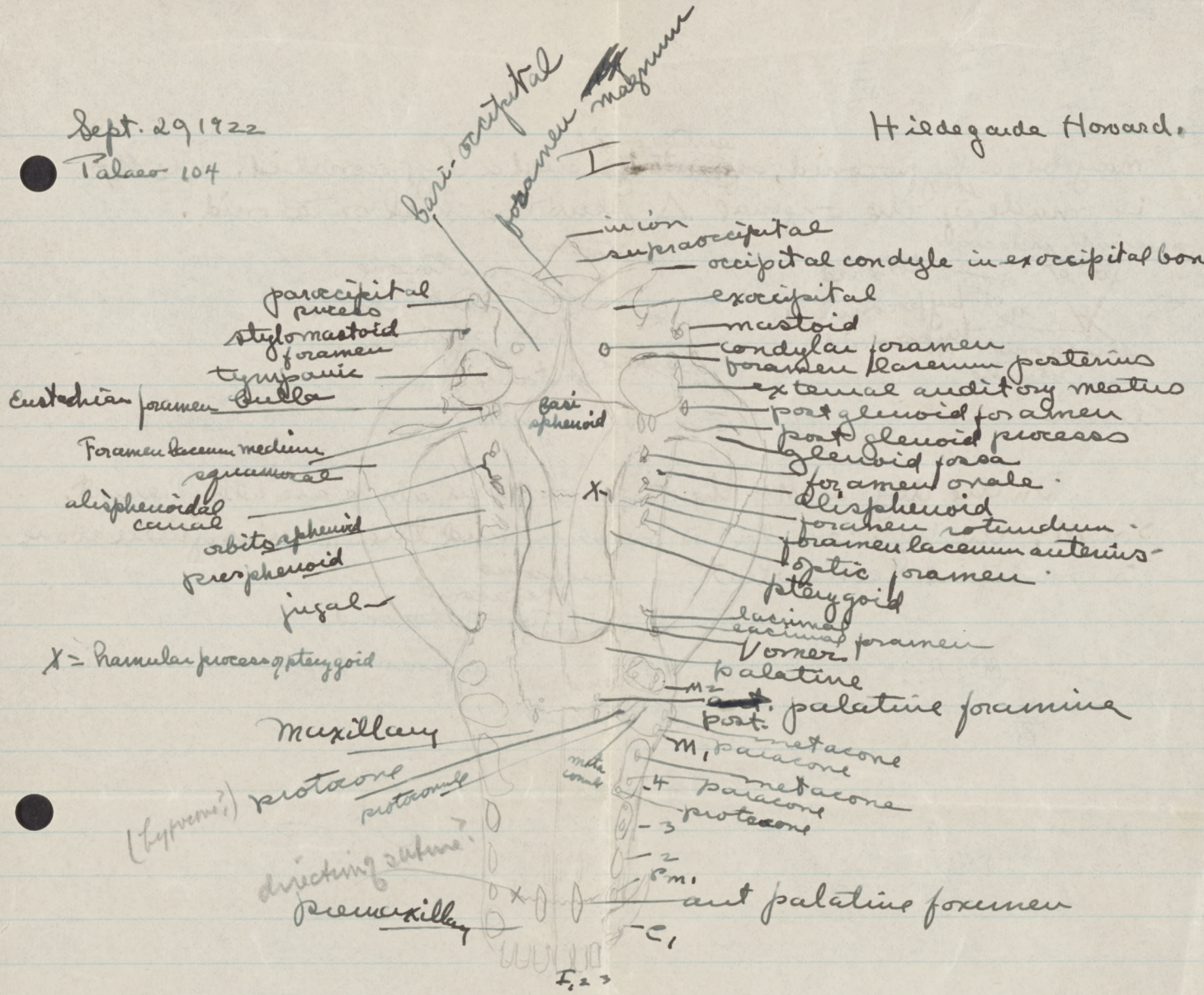
Sept. 29 1922
Palaeo 104

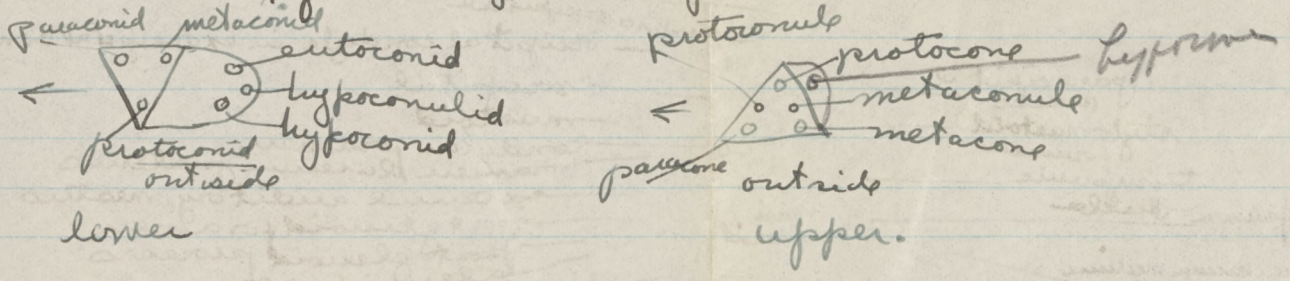
Hildegarde Howard.



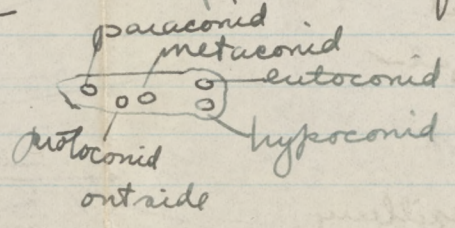
II

The Cope-Osborn theory of Tuberculy is that the primitive mammalian tooth of three cusps in a triangle developed from the triconodont form of tooth in the late reptile where the center cusp is larger than the two on either side ó Ó ò (triconodont). The theory is that the cusps in the triconodont form moved around, either 1 & 2 backward & 3 forward, or vice versa to form the triangular mammalian tooth. In the triconodont form 3 is (according to Osborn) the protocone, representing the main cusp of the typical single cusped reptilian tooth (upper jaw) & 1 & 2 the metacone & paracone. In M^1 the protocone is inside, the paracone & metacone outside - while the reverse is true in M_1 In addition, however, (in some forms, such as the dog M^1) the 3 main cusps are the metaconule between the protocone & the metacone) & the protoconule between the protocone and paracone. (In M^1) & in M_1 the same 3 main names are used with the ending "id". Beside these there

may be a hypoconid, ~~a~~ entoconid and a hypoconulid. The M_1 is made up of the original Δ plus the heel or talonid.



In the dog in M^1 the cusps as given above are all present. In M_1 the hypoconulid is missing and the form as given above is modified somewhat



II

1) Normal mammalian carnivore & primates pass through three stages with up. molars tritubercular (trigonal) and with low. molars tuberculo-sectorial (trigonid + talonid)

2) Triangular arrangement from Triconodont (This proposition has been discarded)

3) In early stages up. & low. molars formed reversed Δs. (Based on observed fact but involves also homology of cusps)

4) Principal cusp in haplodont tooth (reptile) lies on inner side in upper & on outer side in lower molars. (Connected with reversed Δ idea but not necessarily true).

THIS SIDE OF CARD IS FOR ADDRESS

Miss Hildegarde Howard
2943 Harvard Blvd.
Los Angeles,
Calif.

Zoology 106A

Please please

final examination

grade here

92 (Highest Grade.)

Happy New Year.

Thank you!

Hildegarde Howard
Zoology 224

Outline of work in Zoology 224, August 1926 -- May 1927:

Determine genera and species occurring within the ten of birds orders represented in the Emeryville shellmound.

Write up diagnostic characters of each species represented, comparing it with closely allied species.

Work to be divided equally between the two semesters; probably five orders completed each semester.

UNIVERSITY OF CALIFORNIA
MUSEUM OF VERTEBRATE ZOOLOGY

Berkeley, October 4, 1927

COPY FOR MISS HILDEGARDE HOWARD:

Professor J. F. Daniel,
208 Zoology Building,
Campus.

Dear Professor Daniel:

Confirming our agreement in conversation, Monday, November 7, at 9 A. M., has been fixed as the time for the main preliminary doctoral examination of Miss Hildegarde Howard. This will be held in Room 11, Museum of Vertebrate Zoology.

Very truly yours,

(J. Grinnell)

Subcommittee in charge:
Professor Bruce L. Clark
Professor J. F. Daniel
Professor G. D. Louderback
Professor W. D. Matthew
Professor Loye Miller
Professor J. Grinnell.

UNIVERSITY OF CALIFORNIA GRADUATE DIVISION

By action of the Administrative Committee of the Graduate Council the subcommittee in charge of the candidacy for the Ph.D. of

MissHILDEGARDE HOWARD

Major subject: Zoology
Minor subject: Paleontology

has been reconstituted as follows: Professors Grinnell, L.H. Miller, Daniel, Matthew, B.L. Clark, Louderback.

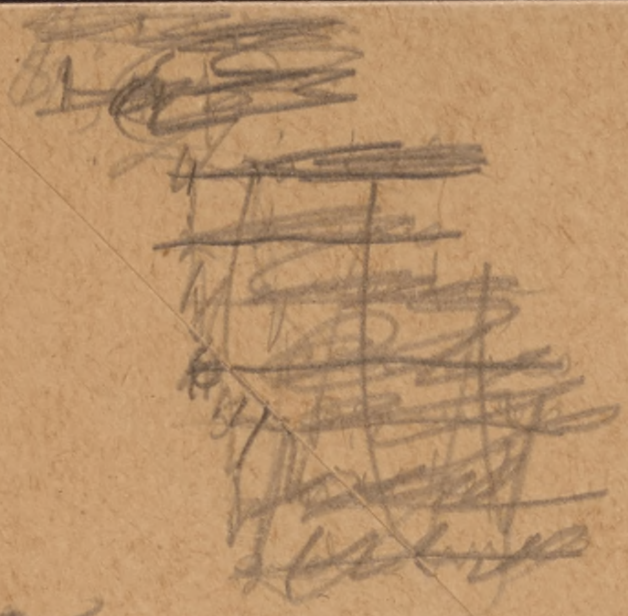
CHAS. B. LIPMAN

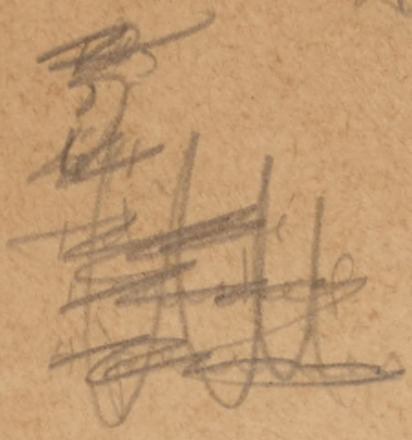
Dean of the Graduate Division

August 27, 1927

UNIVERSITY OF CALIFORNIA
DEAN OF THE GRADUATE DIVISION
BERKELEY, CALIFORNIA

Miss H. Howard
307 Bacon





1945?

Outline of projected
course in Paleomithology for UCLA

Never given

1st 3 weeks becoming acquainted with avian osteology.
2nd 3 weeks avian paleontology

Term paper on
a. Proavis problem
b. Ratite problem
c. Relationship of some groups of fossil birds
1. Pharorachus
2. Diatryma
3. Didus
4. Teratornis
5. Some new species
d. Subject of your choice (get approval)

Next Monday hand in your choice of subject and one or two references from which you expect to get information
Two weeks from then an outline of progress
" " " That Time. - paper due

List of books on Paleornithology & related osteology.
Haliman - Orig. of Birds
Lambrecht - Paleornithologie
Get Wetmore - Birds of the Past in N. America.
10 copies Smith rep. for 1928 pp 377-389 pub 2934
Photo of Archaeornis Matthew & Granger
Lowe - in Proc. Zool Soc. Lond.

I Introduction
What is avian Paleo
Purposes of course

A. Osteology (3 weeks)
1. Birds vs reptiles & mammals
2. Various groups of birds

B. Paleontology (3 weeks
1. History of avian paleo
2. How it compares with other branches of vert paleo
3. Relationship of fossil & recent birds
4. General survey of development of birds

A (in greater detail)
Purpose in studying osteology –
90% fossils are skeletal – only by recognizing recent skeletons can they be allocated
Some are of Recent species even
Others can at least be given nearest relationship – base description on comparison with near relatives.
Necessary to recognize single elements as well as complete skeleton – fragments the usual find
Build the complete from the fragment where relationship is close enough

---

II ☆ Begin by studying generalized skeleton of vertebrate
Complete reptile – and mammal
~~Skulls & vertebrae – for both~~
~~1. Draw skull of each~~
~~2. " vertebrae of each~~
1. " lateral view each and label bones
learn the names of the bones
Law of irreversibility – that once lost never regained so must be replaced by a new structure if needed.

I. In this course I want

1) To acquaint you with the skeleton of birds
   a) as contrasted with reptiles & mammals
   b) Compared to each other

2) To give you an outline of the main accomplishments in certain paleontology
   a) history of work
   b) relationships of the fossils to the recent
   c) general survey of the history birds

The first 3 weeks will be spent in studying the skeleton of the dif. groups of recent birds. This is of utmost importance because 90% of the fossil remains of birds are skeletal. And only as we know & can recognize recent groups of birds are we able to allocate the fossil remains.

Now it is necessary to recognize the individual elements of the skeletal - ~~as well as to know~~ the skeleton as a whole, for rarely (tho occasionally) are complete skeletons discovered. More frequently only a fragment of a single element is found. Many times are posed at the paleontologist who reconstructs a whole animal from a single fragment but I hope it is clear to you that if you are sufficiently familiar with the skeleton of a certain species & find a fragment of a certain element which is identical to

The same element of this known species,
it is no trick at all to know what the
whole kid looked like.

You will remember from your general
palaeontology course that a fossil is any
remains & trace of an organism which was
preserved from a past geologic age. The
2 important points being that (1) the deposit
from which the fossil comes must be geologically
prior to the recent (Pleistocene etc.) & (2) that
by floods of the last century etc.) & (2) that
though the remains found were found in
at this ancient time, the species which they
in the deposit represent need not be may still be
living. Therefore many bones from fossil
deposits of Pleistocene age may agree exactly
with recent skeletons. The older
The fossil, of course, the more it is apt to
differ from the recent, but even so there
is usually a general resemblance which
- with a knowledge of recent skeletons enables
you to place the fossil at least with
nearest relatives.

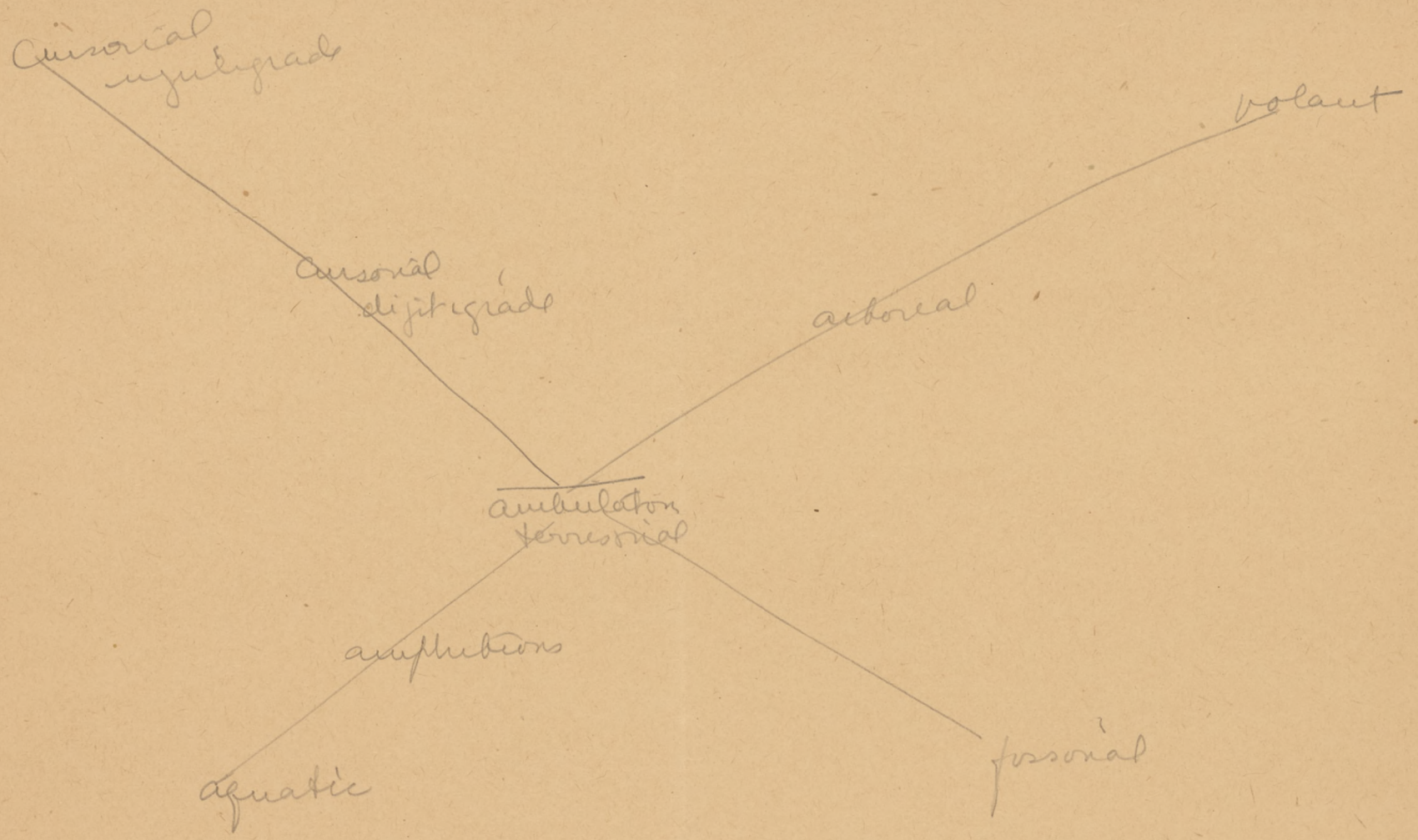
Begin by going over the main bones
of the generalized vertebrate skeleton

III Now that you have an idea of the generalized skeleton of the 3 large classes of vertebrates, I want to call your attention to the skeletal characters which accompany adaptation to different modes of life.

The lizard and the hedgehog are good examples of the generalized (unspecialized) skeletons of a reptile & a mammal. In the chief bones are present unmodified - five toes plantigrade & simple teeth. The bird skeleton on the other hand is highly specialized.

Now vary from this generalized type we may have adaptations - first & all to a more cursorial existence - as you know as you start to run you come up off your heels on to your toes - The same is true of the animals which are runners. The dogs are partly so specialized the horses & deer more so - in the latter forms the animal is running on the tips of its toes & the side toes are no longer in use. The middle foot bones become strong & enlarged forming a "cannon bone"

Turning now to the bird skeleton we find a very similar condition - The three central foot bones united together & raising from the ground. In addition however, some of the tarsal bones fuse with the metatarsals


cursorial
unguligrade
volant
cursorial
digitigrade
arboreal
ambulatory
terrestrial
amphibious
aquatic
fossorial

and we have the tarsometatarsus — a bone peculiar to the Class Aves. The remaining (upper set) of tarsals fuses to the tibia forming the tibio-tarsus. Tho These bones are formed in all birds, the height of the tarsometatarsus from the ground differs in dif. birds. In those birds such as the woodpecker, stork, crane, etc. the bone is practically vertical actually functioning as and other leg bone — while in such birds as the Penguin (?) the loon, etc. it is nearly horizontal.

Adaptation to arboreal life involves another series of changes. The prime necessity is a grasping organ. In the squirrels this may be purely a matter of the claws which are sharp & aid material in clinging. The tail tough not prehensile serves for balance. In these creatures which have an limbs the fingers & toes maybe prehensile as in monkeys or the claws may enlarge into great curved grasping as in the tree sloths. Flying has been developed in all three of the big vertebrate classes, in the reptiles & mammals the wing is formed by a membrane stretched along the arm & between the fingers. The birds, of course are supported by feathers attached along the arm but not between the fingers. Birds are totally dif. from any other vertebrate

(1)
Skull - composed of several bones fused together
Draw mammal + a reptile + a bird skull + label
dorsal, ventral or lateral
Vertebral column -
Draw vertebra of reptile, bird + mammal

Sternum + ribs
Draw sternum of reptile, bird + mammal
girdle - pelvic + shoulder - draw of reptile, bird + mammal
limbs -

humerus	femur
ulna	tibia
radius	fibula
carpals	tarsals
metacarpals	metatarsals
phalanges	phalanges

Draw one limb of reptile, bird + mammal.
and give corresponding bones for other limbs

(2) Draw lateral view of reptile, bird + mammal, labelling main parts

in the structure of the wing. As with foot bones, the hand bones are reduced so that only 3 are represented + one of these is only a process; the lower row of carpals is fused to the united metacarpals + the bone is known as the carpo-metacarpus. The other carpals are free. The phalanges are greatly reduced + are ~~phalanges~~ in most cases. Along the

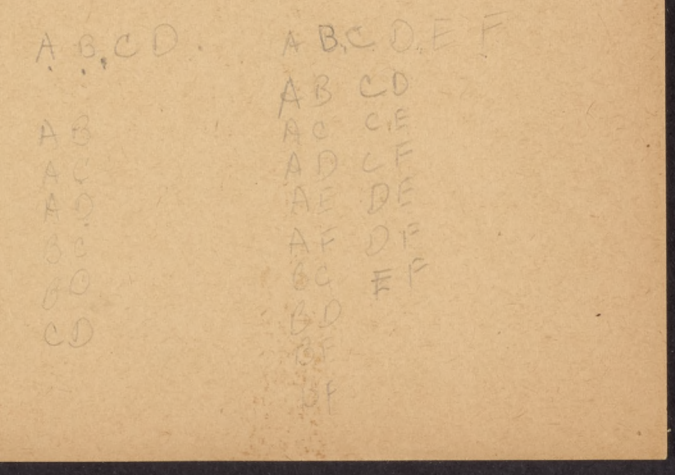
see Heilmann p. 140
Lull - 353-347 - read chap ~~XXII~~ } volant adaptations + pterosaurs etc.
Romer chap ~~IX~~

Draw bat, bird + pterosaur forearm bones + label

IV Adaptive radiation within birds

Although the birds are already highly specialized as compared with the generalized, vertebrate type, there are some adaptations even within this group. Most notable of these, of course are the strictly cursorial birds ~~with~~ lacking flight. The ostriches, emus etc. Then there is the adaptation to life in the

Swaden



cursorial
flightless
birds of long flight
ancestral?
amphibians
winged
amphibians
flightless

References

Camp & Hanna, Methods in Paleontology

Scott, A History of Land Mammals of the Western Hemisphere

Schuchert & Dunbar, Textbook of Geol. part II Hist. Geol.

Reynolds, The Vertebrate Skeleton

Lambrecht, Paleornithologie.

Wetmore, Birds of the Past in N. Amer. Smith Rep 1928 pp 333-389

Heilmann, Origin of Birds

Romer - Vertebrate Paleo (Chap X pp 206-219)

III Continue from generalized skeleton to more detailed study

A. Basic differences between birds & reptiles & mammals

1. Bone structure

fill in →

2. Epiphyses in mammals

3. Shape of vertebrae

Draw vertebra of mammal, bird & reptile lateral

4. Skull development - Learn bones of skull

Draw and label bones in skull of bird, reptile, mammal

5. Shoulder & pelvic girdles

6. Limb bones

fusion of metatarsals & tarsals

" " carpals " carpals

Draw lateral view of bird & label as with reptile & mammal.

IV Modification of skeleton in keeping with adaptation from a generalized ambulatory terrestrial type, adaptations

under 1. digging into ground

on 2. running faster on the ground - 2 stages

water 3. taking to water - 2 stages

above 4. above the ground - arboreal or flying.

Of these we are interested particularly in 2 and 4

skeletal adaptations for running

heel off ground - body raising up, consequent lengthening of metatarsal - reduction in no. of toes.

Skeletal adaptations for arboreal life
a. clinging or grasping organ
prehensile toes
" tail

clavc

Skeletal adaptations for flying
Nature has produced flight in
reptiles - patagium + lengthened 1 finger
mammals - " " " 4 fingers
birds - small patagium, feathers, reduced hand bone
Sternum large flat bone in pterosaurs + birds
but not bats
Difference in feet ? birds vs. pterosaurs + bats
terrestrial org.? vs arboreal origin?

V Laboratory
VI Origin of birds - all lecture

Wed Lab

VII Classification of birds - based on relationships

A Place of birds in animal world

Animal + Plant Kingdoms

Animal kingdom has about 12 major div.:

1. Beginning with unicellular forms
2. Thru simple types of many celled forms without backbone
3. To the more highly developed animals having a back bone

The vertebrates are further divided into classes including the

fishes
amphibians } cold-blooded
reptiles
birds
mammals } warm-blooded

B The class Aves - see list

Considering first of all the recent orders

The main distinctions between the Palaeognathae or ratites + the Neognathae or carinates

1. ilium + pubis not connected in ratites
2. Sternum lacking keel "
3. reduced wing bones
4. well developed tarsometatarsus
5. flattened coracoid + Scapula united distad
6. Palate ratites with carinates +

Laboratory - compare Archaeopteryx - wing similarities + reverse. also with reptiles

VIII Classification - continued - identification

Superorder Neognathae

Orders Sphenisciformes — penguin

Questions must Gaviiformes — loon

would help, Colymbiformes — grebe

Procellariiformes, albatross, shearwater, petrel

Pelecaniformes, pelican, cormorant, booby

IX Ident. cont'd

Order Ciconiiformes - Heron, stork, ibis

" Gruiformes - crane, coot

" Anseriformes - Duck, goose

" Charadriiformes - snipe, gull, auk

X Ident. cont'd

Order Galliformes - chicken, quail, Turkey

" Columbiformes - pigeon

" Psittaciformes - parrot

XI Ident. cont'd

Order Falconiformes - hawk, falcon, vulture

" Strigiformes - owls

XII Ident cont'd

Order Caprimulgiformes - goatsucker

" Micropodiformes - swift

" Coraciiformes - kingfisher

" Piciformes - woodpecker

" Passeriformes - Raven - meadowlark

XIII Catchup

~~XIV~~ Trip to Museum to study skeletons
~~XV~~ Identification examination - students select element they know best. Using fossils

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XVI Preservation of birds as fossils ~~history of fossils~~

XVII History of avian fossils & its present status
no. of localities
no. of species known compared with mammals

XVIII

Osteology

1 Basic skeletal elements
2 Main differences bet. reptiles, birds & mammals
3 Adaptations - general discussion
4. Terrestrial (cursorial), fossorial
5. arboreal, volant

6. Classification of birds - general discussion
7. Main chars. of Palaeognathae vs. Neognathae
8. Diagnostic elements within Neognathae
9. Concentration on characters raptores & distinction bet. falconif & strigi
10 concen. on characters of divers & distinctions bet. 5 main orders
11 " " " " charadriiformes & anseriines
12 Quiniformes, ciconiiformes
13 columbiformes, galliformes & parrots
14 ~~kingfishers, swifts~~ woodpeckers & passerines

Paleornithology
15. Fossil birds Their rel. to paleo as a whole - mus. etc - localities - & bones
16 History of Paleornithology
17. Types of preservation of fossil birds
18.
19.

20 Origin of birds & Archaeopteryx
21 Cretaceous birds
22 Tertiary birds
23 Recents "
24 " "
25 Some aspects of avian paleontology revealed by fossil birds
26 Distribution of birds
27 Ratite problem
28 Evolution
29 ←

Relationship of certain fossil birds
Phorusrachus,
Diatryma
Didus
Tecatornis
Aepyornis,
R. L. B. extinct birds

UNIVERSITY OF CALIFORNIA
MUSEUM OF PALEONTOLOGY
BERKELEY, CALIFORNIA

Nov. 23, 1949

Dear Hildegarde:

A general announcement of the symposium was made at the El Paso Meetings and a general invitation issued there. You would be greeted here most warmly if you care to attend.

The first day, Dec. 14 at 3 P.M. Mining Bldg
Ted McCown + Bob Heizer on fossil man in general + S. Cal. in particular
Osteol. artifacts principally.

Second day, Dec. 15 at 2 P.M. Mining Bldg.
Frank Peabody, Camp + Bob Rodine
Geol. + dating of S. Cal. Caves

Third day, Dec. 16 3 P.M. Mining Bldg.
Prof R. A. Dart on Manapes, ecology habits + phylogeny.

Hope to see you
Camp